### (12) INTERNATIONAL APPLICATION PUBLISHED UNDER THE PATENT COOPERATION TREATY (PCT)

# (19) World Intellectual Property Organization International Bureau



# 

(43) International Publication Date 6 May 2004 (06.05.2004)

**PCT** 

# (10) International Publication Number WO 2004/037714 A3

(51) International Patent Classification<sup>7</sup>: C01B 31/30

B32B 5/16,

(21) International Application Number:

PCT/US2003/010822

(22) International Filing Date:

9 April 2003 (09.04.2003)

(25) Filing Language:

**English** 

(26) Publication Language:

English

(30) Priority Data:

60/370,732

9 April 2002 (09.04.2002) US

(63) Related by continuation (CON) or continuation-in-part (CIP) to earlier application:

US Filed on 60/370,732 (CON) 9 April 2002 (09.04.2002)

(71) Applicant (for all designated States except US): MASS-ACHUSETTS INSTITUTE OF TECHNOLOGY [US/US]; 77 Massachussets Avenue, Cambridge, MA 02142-1324 (US).

(72) Inventors; and

(75) Inventors/Applicants (for US only): CHIANG, Yet-Ming [US/US]; 52 Lake Road, Framingham, MA 01701 (US). VANDER SANDE, John, B. [US/US]; 5 High Road, Newbury, MA 01961 (US).

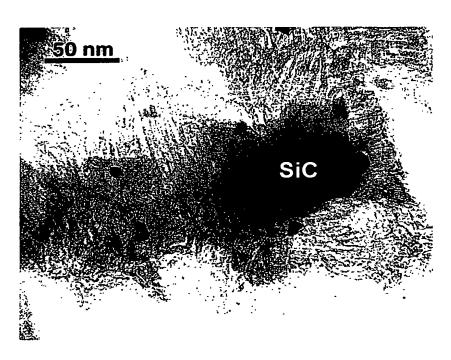
(74) Agent: FOX, Harold, H.; Steptoe & Johnson LLP, 1330 Gonnecticut Avenue, NW, Washington, DC 20036 (US).

(81) Designated States (national): AE, AG, AL, AM, AT, AU, AZ, BA, BB, BG, BR, BY, BZ, CA, CH, CN, CO, CR, CU, CZ, DE, DK, DM, DZ, EC, EE, ES, FI, GB, GD, GE, GH, GM, HR, HU, ID, IL, IN, IS, JP, KE, KG, KP, KR, KZ, LC, LK, LR, LS, LT, LU, LV, MA, MD, MG, MK, MN, MW, MX, MZ, NO, NZ, OM, PH, PL, PT, RO, RU, SD, SE, SG, SK, SL, TJ, TM, TN, TR, TT, TZ, UA, UG, US, UZ, VN, YU, ZA, ZM, ZW.

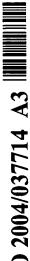
(84) Designated States (regional): ARIPO patent (GH, GM, KE, LS, MW, MZ, SD, SL, SZ, TZ, UG, ZM, ZW), Eurasian patent (AM, AZ, BY, KG, KZ, MD, RU, TJ, TM), European patent (AT, BE, BG, CH, CY, CZ, DE, DK, EE, ES, FI, FR, GB, GR, HU, IE, IT, LU, MC, NL, PT, RO, SE, SI, SK, TR), OAPI patent (BF, BJ, CF, CG, CI, CM, GA, GN, GQ, GW, ML, MR, NE, SN, TD, TG).

[Continued on next page]

(54) Title: CARBON NANOPARTICLES AND COMPOSITE PARTICLES AND PROCESS OF MANUFACTURE



(57) Abstract: Carbide powders can be partially or completely converted to substantially densely-packed carbon nanotubes by thermochemical treatment. When partially converted, the resulting materials can consist of a metal carbide core, such as silicon carbide, onto which a surface layer of fullerenic carbon, such as carbon nanotubes, has been grown.





#### Published:

- with international search report
- before the expiration of the time limit for amending the claims and to be republished in the event of receipt of amendments
- (88) Date of publication of the international search report: 2 September 2004

For two-letter codes and other abbreviations, refer to the "Guidance Notes on Codes and Abbreviations" appearing at the beginning of each regular issue of the PCT Gazette.

## INTERNATIONAL SEARCH REPORT

International application No.

PCT/US03/10822

A. CLASSIFICATION OF SUBJECT MATTER		
IPC(7) : B32B 5/16; C01B 31/30 US CL : 428/323, 328, 330, 402.24, 404, 689; 423/345, 350, 439		
According to International Patent Classification (IPC) or to both national classification and IPC		
B. FIELDS SEARCHED		
Minimum documentation searched (classification system followed by classification symbols) U.S.: 428/323, 328, 330, 402.24, 404, 689; 423/345, 350, 439		
Documentation searched other than minimum documentation to the extent that such documents are included in the fields searched		
Electronic data base consulted during the international search (name of data base and, where practicable, search terms used) EAST		
C. DOCUMENTS CONSIDERED TO BE RELEVANT		
Category * Citation of document, with indication, where a		
A, P US 2002/0102196 A1 (SMALLEY et al) 01 August 2002 (01.08.2002), pages 1-32		1-49
A US 5,547,748 A (RUOFF et al) 20 August 1996 (20	A US 5,547,748 A (RUOFF et al) 20 August 1996 (20.08.1996), columns 1-16	
Further documents are listed in the continuation of Box C.	See patent family annex.  "T" later document published after the int	americant filing data or ariority
* Special categories of cited documents:  "A" document defining the general state of the art which is not considered to be of particular relevance	"T" later document published after the int date and not in conflict with the appli principle or theory underlying the inv "X" document of particular relevance; the	cation but cited to understand the vention
"E" earlier application or patent published on or after the international filing date	considered novel or cannot be considered when the document is taken alone	
"L" document which may throw doubts on priority claim(s) or which is cited to establish the publication date of another citation or other special reason (as specified)	"Y" document of particular relevance; the considered to involve an inventive ste combined with one or more other suc	p when the document is
"O" document referring to an oral disclosure, use, exhibition or other means	being obvious to a person skilled in t	he art
"P" document published prior to the international filing date but later than the priority date claimed	"&" document member of the same patent	·
Date of the actual completion of the international search 27 June 2004 (27.06.2004)	Date of mailing of the international search report  20 JIII 2004	
Name and mailing address of the ISA/US	Authorized officer	1 /1.7
Mail Stop PCT, Attn: ISA/US Commissioner for Patents P.O. Box 1450	SAMUEL A. ACQUAH	
Alexandria, Virginia 22313-1450 Facsimile No. (703) 305-3230	Telephone No. 571-272-1700	